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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/072,907	02/12/2002	Soo Seok Choi	1567.1022	3556

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STAAS & HALSEY LLP  
SUITE 700  
1201 NEW YORK AVENUE, N.W.  
WASHINGTON, DC 20005

EXAMINER
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ALEJANDRO, RAYMOND

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 02/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/072,907

Applicant(s)

CHOI ET AL.

Examiner

Raymond Alejandro

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 06 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-39 is/are pending in the application.
- 4a) Of the above claim(s) 18-37 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-17, 38 and 39 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 February 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 02/12/02
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Election/Restrictions*

1. Applicant's election with traverse of Group I (claims 1-17 and 38-39) in Paper No. 01/06/04 is acknowledged. The traversal is on the ground(s) that *"the other groups are so closely related to elected Group I...that the evaluation of the other set of claims would not provide an undue burden upon the examiner"* and *"no references has been cited to show any necessity for requiring restriction"*. This is not found persuasive because the particular search for the elected claims 1-17 and 38-39 classified in class 429/218.1 is not required for both sets of non-elected claims 18-28 classified in class 427/58 and claims 29-37 classified in class 429/33, that is, the search required for the lithium-sulfur battery is not particularly required for either the method of preparing the positive electrode or the positive electrode per se. As admitted by the applicants, the inventive concepts involve three different and independent inventions as recited above. Further, since the restriction requirement of Group I-II has been treated as unrelated, it is further noted that the inventions are unrelated because the lithium-sulfur battery is a power generating device while the method is for preparing an electrochemical component, and thus, they have different modes of operation, different effects and different functions. With respect to Group I-III, the restriction has been imposed as combination and subcombination, accordingly, the battery can comprise any other electrochemical active material such as a chalcogenide compound or metal oxide or complex metal oxide, thus, the battery does not require the specific electrode material; and the positive electrode per se is simply an electrochemical feature which can be used in electroplating, electrolyzers, gas sensors, separation membranes and the like, thus, it has separate utility. As to the Group II-III, the restriction has been treated as process of making

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and product, accordingly, the positive electrode as claimed can be made by another and materially different process such as: i) adding the plasticizer to a slurry, or ii) without using elemental sulfur by coating a current collector having pores with a mixture of the binder and the conductive agent but not using the elemental sulfur (*as admitted by the applicants, see sections 0034-0036*); additionally, the mixing step can be any of the following: a) prolonged slurry mixing, b) shear mixing, c) ball mixing, or d) vibromilling of the slurry or d) cryogenic milling of the frozen slurry. Accordingly, serious burden would be raised if the specific search of the three different groups was made as required for these separate and distinct inventions.

With respect to the election of species, it is noted that all claims of Group I will be examined on the merits, thus, said election requirement is being withdrawn.

The requirement is still deemed proper and is therefore made **FINAL**.

#### ***Priority***

2. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

#### ***Information Disclosure Statement***

3. The information disclosure statement (IDS) submitted on 02/12/02 was considered by the examiner.

#### ***Drawings***

4. The drawings were received on 02/12/02. These drawings are acceptable.

***Specification***

5. The disclosure is objected to because of the following informalities: the term "calcogenide" is misspelled. Appropriate correction is required.
6. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

***Claim Rejections - 35 USC § 102***

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1-4, 8-17 and 38-39 are rejected under 35 U.S.C. 102(b) as being anticipated by Chu 5523179.

The present claims are drawn to a lithium-sulfur battery wherein the disclosed inventive concept comprises the specific positive active material.

As to claim 1:

Chu discloses battery cells comprising a sulfur-based positive composite electrode wherein the active sulfur is elemental sulfur or sulfur containing discharge products of elemental sulfur; a negative electrode comprises lithium metal such as lithium metal or lithium-aluminum alloys (ABSTRACT/CLAIM 1/ CLAIM 9). It is disclosed that the positive electrode comprises an electronically conductive material and an ionically conductive material (COL 5, lines 1-9).

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The electrolyte separator is also taught (CLAIM 1). It is disclosed that the electrolyte separator for solid state batteries functions as a separator for the positive and the negative electrodes, and as a transport medium for the metal ions (COL 11, lines 9-15). It is also disclosed that for battery cells containing a liquid electrolyte such battery format contains a separator within the liquid electrolyte (COL 11, lines 35-42). *Thus, the battery cell has a separator and an ion-conducting electrolyte.*

*Examiner's note: it is noted that the limitation "pores of an average size of up to 20  $\mu\text{m}$ " does include 0 (zero) as a lower limit. Thus, the foregoing limitation reads on "pore-free material", or "0 % of porosity at all". (See MPEP 2173.05(c) Numeral Ranges & Amounts Limitations, II. Open-Ended Numeral Ranges).*

As to claims 2-3:

It is noted that the limitation "pores of an average size of up to 20  $\mu\text{m}$ " does include 0 (zero) as a lower limit. Thus, the foregoing limitation reads on "pore-free material", or "0 % of porosity at all". (See MPEP 2173.05(c) Numeral Ranges & Amounts Limitations, II. Open-Ended Numeral Ranges).

As to claims 4, 8, 10-14, and 16:

Chu teaches the use of elemental sulfur per se and conductive material (COL 4, lines 27-35/ COL 5, lines 1-15); it is disclosed that the term "active sulfur is defined to be elemental sulfur or sulfur that would be elemental if the positive electrode were in its theoretical fully charged state (COL 8, lines 32-35); it may also comprise binders (COL 5, lines 25-28). This composition is intermixed (COL 5, lines 1-8); it's dispersed in a composite matrix by being

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mixed (COL 8, line 45 to COL 10, line 10). It is disclosed that the positive electrode slurry is cast directly onto a SS current collector (COL 10, lines 58-65).

*Furthermore, as to the method limitation, i.e. i) mixing (ball mill), ii) coating, iii) removing, iv) injecting, v) employment of a plasticizer and its removing solvent and the likes, it is further noted that a method limitation incorporated into a product claim does not patentable distinguish the product because what is given patentably consideration is the product itself and not the manner in which the product was made. Therefore, the patentability of a product is independent of how it was made. In this regard, it is thus noted that since the plasticizer is removed from the positive electrode, the plasticizer and the removing solvent are not an active constituent of said positive electrode. That is, the plasticizer and the removing solvent were just employed as part of the preparation technique but the plasticizer was removed thereafter by using the solvent. Further, since the porosity of the positive electrode as claimed also includes "0 (zero) porosity" or "a pore-free material", it is hence asserted that no plasticizer and removing solvent is required.*

As to claim 9:

Chu discloses the presence of polysulfide form material (COL 4, lines 30-36/ COL 4, lines 60-65).

As to claim 15:

Chu discloses the use of, at least, polyethylene oxide (COL 10, lines 46-55/ COL 9, lines 45-60/ COL 5, lines 9-15).

As to claim 17:

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Chu discloses the ionic conductor in the positive electrode can be any of the solid-state or gel-state electrolytes described in the electrolyte separators and liquid electrolyte sections (COL 10, lines 23-27) as well as any electronically insulating and ionically conductive material which is electrochemically stable may be used (COL 10, lines 46-55/ COL 9, lines 45-60/ COL 5, lines 9-15). In particular, Chu teaches the following organic liquids of the battery cell incorporating the positive electrode: propylene carbonate; ethylene carbonate, N-methylpyrrolidinone, butyrolactone, tetramethylurea and the likes (COL 11, lines 26-35).

As to claims 38:

Chu teaches the employment of solid electrolytes (Col 11, lines 8-15/ COL 5, lines 62-67/ Col 10, lines 23-27).

As to claim 39:

Chu teaches the use of polymeric, glass and/or ceramic materials are appropriate as solid-state electrolyte separators (Col 5, lines 62-67).

Thus, the claims are anticipated.

***Claim Rejections - 35 USC § 103***

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various

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claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu 5523179 as applied to claim 4 above, and further in view of Kovalev et al 6652440.

Chu is applied, argued and incorporated herein for the reasons above. However, Chu does not expressly disclose the specific particle size of the elemental sulfur.

Kovalev et al teach electroactive cathode materials for electrochemical cells (COL 1, lines 10-15) wherein the cathode materials comprise sulfur-sulfur bond such as elemental sulfur (COL 1, lines 43-50). It is disclosed that such cathode materials are useful in batteries employing alkali-metal anode, in particular, lithium or lithium-alloy anodes (COL 1, lines 35-53/COL 16, lines 64-67). It is further disclosed that in one embodiment, the particle size of elemental sulfur is from 0.01 to 100 microns (COL 5, lines 18-20/COL 12, lines 7-9). *It is noted that Kovalev et al's particle size range encompasses, at least, particle sizes up to 20  $\mu\text{m}$ , or 10  $\mu\text{m}$  or 5  $\mu\text{m}$ .*

In light of these disclosures, it would have been obvious to one skilled in the art at the time the invention was made to use the specific particle size of the elemental sulfur of Kovalev et al in the lithium-sulfur battery of Chu as Kovalev et al teach that elemental sulfur having the claimed particle size is useful for making positive electrode of lithium-sulfur batteries because this particular positive electrode material exhibits satisfactory specific capacity in combination with a lithium anode. As a consequence, lithium-sulfur batteries employing elemental sulfur

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having the claimed particle size as positive electrode achieves high energy capacity and rechargeability by the electrochemical cleavage via reduction and reformation via oxidation of the elemental sulfur. *Hence, Kovalev et al directly teach the use of elemental sulfur having a particle size within the claimed range.*

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (571) 272-1282. The examiner can normally be reached on Monday-Thursday (8:00 am - 6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Raymond Alejandro  
Examiner  
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A handwritten signature in black ink, appearing to read 'RAM', with a horizontal line underneath.